Fabrication of Photonic Crystals Using Single Refracting Prism Holographic Lithography

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As being able to produce defect-free, nanometer-scale structures over large area uniform PhCs in a single step fabrication, holographic lithography has shown to be a very economy and powerful tool and might hold the key to volume producing of photonic structures. In the previous demonstrations, however, multiple beams forming the interference pattern were obtained by two independent optical elements and steps: splitting the laser output into multiple beams either by a dielectric beam splitter or a grating; and then superposing them at the exposure area by another specially designed prism. This fabrication strategy can introduce alignment complexity and inaccuracies due to differences in the optical path length and angles among the interfering beams as well as vibrational instabilities in the optical setup. We now demonstrate another approach for easy fabrication of 2D and 3D photonic crystal microstructures, based on beam splitting and overlapping by a single refracting prism. 3- and 4-beam interference pattern is generated and recorded in a photosensitive polymer. This method enables splitting of an incoming laser beam into multiple beams and at the same time, recombining them by the same optical element. Thus, anti-vibration equipment and complicated optical alignment system to adjust the angles between the interfering beams are not required, leading to a very simple optical setup. Temporal overlap of the divided pulses will be able to be achieved without adjusting the optical path lengths if a pulsed laser to be applied in the fabrication. In the context of mass production, this method is much more practical and robust than those previous demonstrations by two independent-element setups.